



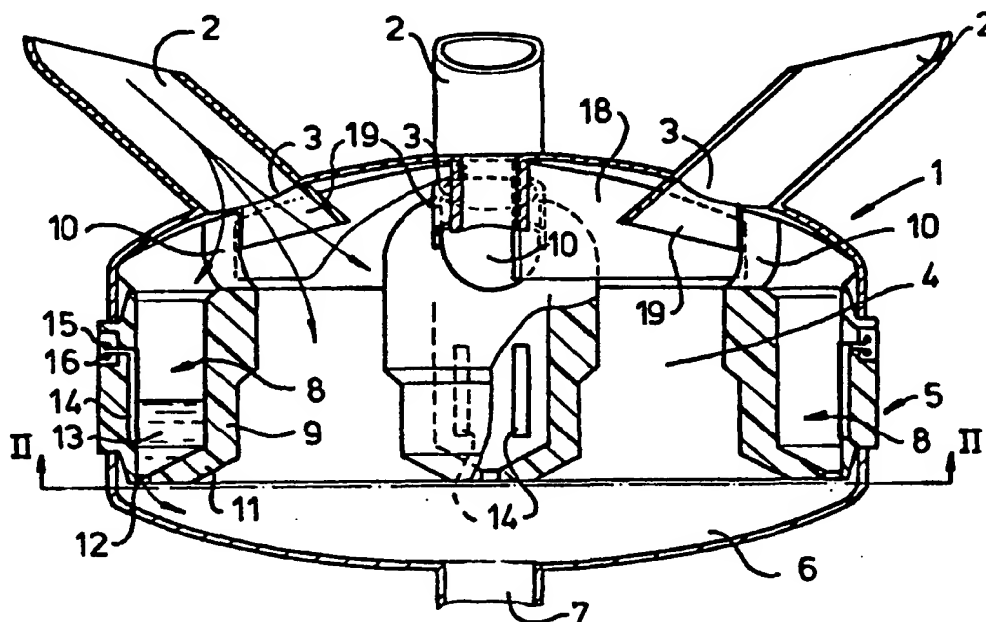
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup>:</b> <b>A01J 5/04, 7/00, G01N 33/04</b>	<b>A1</b>	<b>(11) International Publication Number:</b> <b>WO 95/22888</b> <b>(43) International Publication Date:</b> 31 August 1995 (31.08.95)
<b>(21) International Application Number:</b> PCT/NL95/00047 <b>(22) International Filing Date:</b> 2 February 1995 (02.02.95)  <b>(30) Priority Data:</b> 9400305                      28 February 1994 (28.02.94)      NL  <b>(71) Applicant (for all designated States except US):</b> GASCOIGNE-MELOTTÉ B.V. [NL/NL]; Gildenweg 2, P.O. Box 1068, NL-8300 BB Emmeloord (NL).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> NIJKAMP, Jan, Marinus [NL/NL]; Westergolaan 11, NL-8302 LE Emmeloord (NL). POSTHUMA, Berend, Andries [NL/NL]; Maasstraat 25, NL-8303 LP Emmeloord (NL).  <b>(74) Agents:</b> DE BRUIJN, Leendert, C. et al.; Nederlandsch Octrooibureau, Scheveningseweg 82, P.O. Box 29720, NL-2505 LS The Hague (NL).		<b>(81) Designated States:</b> US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** DEVICE FOR MEASURING THE COMPLEX IMPEDANCE OF MILK, AND PULSATOR HAVING SUCH A DEVICE

**(57) Abstract**

A device for measuring the complex impedance, such as the electrical conductance and/or the capacitance, of milk, for example in connection with mastitis detection, comprises a sample chamber which is provided with sensors and in which a milk sample can be received. The sensors are mounted in the sample chamber at an essentially mutually equal height level. The sensors may also have an elongated shape and be mutually parallel.



**FOR THE PURPOSES OF INFORMATION ONLY**

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo			SE	Sweden
CH	Switzerland	KR	Republic of Korea	SI	Slovenia
CI	Côte d'Ivoire	KZ	Kazakhstan	SK	Slovakia
CM	Cameroon	LI	Liechtenstein	SN	Senegal
CN	China	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
CZ	Czech Republic	LV	Latvia	TJ	Tajikistan
DE	Germany	MC	Monaco	TT	Trinidad and Tobago
DK	Denmark	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	US	United States of America
FI	Finland	ML	Mali	UZ	Uzbekistan
FR	France	MN	Mongolia	VN	Viet Nam
GA	Gabon				

Device for measuring the complex impedance of  
milk, and pulsator having such a device

The invention relates to the field of measuring the complex impedance, such as the electrical conductance and/or the capacitance, of milk, for example for detecting mastitis in dairy animals. In that connection, it is known to use, in a milking installation, a detection device which has a sample chamber in which a milk sample can be received. The sample chamber is generally so designed that the milk sample received therein stays relatively stationary for some time so that the conductance of the milk can be measured by means of the sensors.

EP-B-137 367 discloses some embodiments of such a sample chamber. Thus, the short milk hose between the teat cup and the pulsator may be provided, over a section of its length, with an insulated channel which opens out again via a small opening into the main channel. Two electrodes are mounted in the insulated channel.

As an alternative, it is also known to constrict the milk hose locally so that a stagnation point occurs in the milk flow. Mounted just in front of the constriction are the electrodes which measure the conductance of the relatively slowly flowing milk.

It is furthermore known, to provide, in the pulsator itself, sample chambers in which the electrodes are sited.

In all these known detection devices, however, the problem arises that the measurements of the impedance obtained are inaccurate. The consequence of this is that said measurements are not reliable enough and cannot provide any clear information relating to the presence or absence of mastitis. The object of the invention is therefore to provide such a device which will in fact yield reliable results.

That object is achieved in that the sensors are mounted in the sample chamber at an essentially mutually equal height level. At the same time, the reliability can be increased still further if the sensors have an elongated shape and are mutually parallel. If the elongated sensors are, in addition, transverse to the milk surface within a certain angular range, for example between  $0^\circ$  and  $\pm 45^\circ$ , fluctuations in the flow rate of the milk sample do not have any influence on the measuring accuracy. An elongated shape must be understood as meaning any shape in which a clear longitudinal direction can be distinguished, such as a rectangle, oval, exclamation mark etc.

Such fluctuations in the flow rate of the milk sample in th

sample chamber are the consequence of the pulsating nature of the milk flow and the varying rate at which the animals deliver their milk; with such an arrangement and design of the sensors, however, they have hardly any influence on the measurements, as a result of which a very constant, reliable picture is obtained.

As already discussed above, such a sample chamber can be received in the short milk hose itself. Preferably, however, such a measuring device is provided in a pulsator for a milking installation. The pulsator disclosed in EP-B-137 367 contains, in a known manner, a collecting space having a lid which has feed openings which may each be connected to a teat cup of the milking device, in which collecting space sample chambers are separated off for receiving a milk sample originating from an associated teat cup, which sample chambers are each provided with sensors for measuring the complex impedance of the milk.

In such a pulsator, an important improvement in the measurements can be obtained if the sensors are situated next to one another when viewed in the circumferential direction of the collecting space. In this arrangement, the sensors are situated at equal levels when viewed in the vertical direction. In this case, too, the influence of fluctuations in the milk supply can largely be eliminated if the sensors have an elongated shape, and the longitudinal direction of the sensors is directed perpendicularly to the circumferential direction of the collecting space.

Each sample chamber can be designed so that it is bounded, on the one hand, by a chamber wall extending into the collecting space from the circumferential wall and, on the other hand, by the adjacent part of the circumferential wall.

If said chamber wall terminates at some distance below the associated feed opening, the main flow of the milk squirts along the sample chamber directly into the collecting space. Only a fraction of the total flow enters the sample chamber, for example dropwise, as a result of which a milk sample can collect therein which stays relatively stationary. In such a state, accurate measurements can be made.

The chamber wall is sealed off at the bottom with respect to the circumferential wall and is provided with a drainage opening. The milk slowly flows back out of the sample chamber via the opening so that a fresh milk sample can always be measured.

In order to prevent measurements of one milk sample originating from one teat cup being disturbed as a consequence of the entry of milk

from another teat cup, the lid is provided, on its inside, with partitions which extend radially up to the area between two openings. The partitions hold back even the finest milk drops so that each sample chamber receives only milk from the associated teat cup. A reliable measurement is thus ensured also for each quarter.

As an alternative, an approximately semicylindrical wall whose open side is directed towards the circumferential wall may be provided around each opening.

An exemplary embodiment of a pulsator according to the invention will be explained in greater detail below by reference to the figures.

Figure 1 shows a side view in cross section of a pulsator according to the invention.

Figure 2 shows a bottom view of the pulsator according to Figure 1.

The pulsator shown in Figure 1 comprises, in a known manner, a lid 1 which carries four feed pipe pieces 2 (of which only three are visible in Figure 1). Each pipe piece is connected via opening 3 in the lid to the interior of the pulsator, designated as collecting space 4.

The lid is attached to the circumferential wall 5, which is sealed at its bottom by base 6. Said base 6 furthermore carries a drainage pipe 7, via which the milk is drained into a milking installation.

Each feed pipe piece 2 is connected in a known manner to a flexible short milk hose which is not shown in further detail and is connected to a teat cup, which is also not shown.

Mounted underneath each feed opening 3 in the collecting space 4 is a so-called sample chamber 8. Each sample chamber 8 is bounded by an essentially semicylindrical chamber wall 9 and the adjacent section of the circumferential wall 5. At the top, the chamber wall 9 has a cutout 10, via which a portion of the milk which flows into the collecting space 4 through the feed pipe piece 2 enters the sample chamber 8. The main flow of the milk supply is directed straight into the collecting space 4, which means that only a small part of the milk enters said sample chamber 8, for example dropwise.

The chamber wall 9 is connected at the bottom to the circumferential wall 5 by means of a base wall 11. In said base wall there is a small opening 12, via which opening 12 the milk sample 13 collecting in the sample chamber 8 slowly drains away.

According to the invention two sensors in the form of electrodes 14 are now mounted on the inside of the circumferential wall 5. The surfaces of said electrodes are in contact with the milk sample 13. Each electrode is connected to an electrical conductor 15 or 16.

- 5 The conductors needed may be connected via cable 17 to a measuring device which is not shown in further detail. As already mentioned, for example, conductance and/or capacitance measurements may be involved.

As can be seen in Figure 1, the electrodes 14 are mounted, in the operating state of the pulsator, at the same level. They furthermore have an elongated shape and are transverse to the surface of the milk sample 13 in the sample chamber 8. In practice, the pulsator may be suspended in an inclined position. Within certain limits, for example up to an inclined position of 45° with respect to the milk surface, reliable measurements can nevertheless be performed. Owing to this positioning and design of the electrodes, a reliable measurement can always nevertheless be obtained even with varying flow rate as a consequence of severe fluctuations in the height of the milk surface of the milk sample 13. After all, it is always ensured that both electrodes are in contact with the milk; in addition, placing the sample chamber in a relatively quiet region of the collecting space 4 ensures that the milk sample 13 stays relatively stationary. In addition, the milk sample 13 stays in the sample chamber 8 for a relatively long time, since the milk can drain away only slowly through the drainage opening 12. All these measures contribute to the accuracy of the measurement result obtained.

- 25 Four partitions 18 are furthermore mounted in the lid 1. Each partition 18 extends from the centre of the lid to the circumferential wall 5 and runs between two feed openings 3. Said partitions 18 ensure that only milk from the feed opening 3 situated directly above it enters each sample chamber 8. It is thus possible to detect reliably which teat of the animal being milked is suffering from mastitis. In addition to, or instead of, said partitions 18, an approximately semicylindrical wall 19 can be mounted at each opening 3.

- 30 A sensor for measuring the milk temperature, which is a good indication of the body temperature of the animal, can be mounted in one of the sample chambers 8.

Claims

1. Device for measuring the complex impedance, such as the electrical conductance and/or the capacitance, of milk, for example in connection with mastitis detection, comprising a sample chamber which is  
5 provided with sensors and in which a milk sample can be received, characterized in that the sensors are mounted in the sample chamber at an essentially mutually equal height level.
2. Device according to Claim 1, wherein the sensors have an elongated shape and are mutually parallel.
- 10 3. Device according to Claim 2, wherein the longitudinal direction of the sensors is directed essentially transversely or at an angle to the surface of the milk sample.
4. Pulsator for a milking installation, which pulsator is provided with a measuring device according to one of the preceding claims and  
15 comprises a collecting space having a lid which has feed openings which may each be connected to a teat cup of the milking installation, in which collecting space sample chambers are separated off for receiving a milk sample originating from an associated teat cup, which sample chambers are each provided with sensors for measuring the complex impedance of the  
20 milk, characterized in that the sensors are situated next to one another when viewed in the circumferential direction of the collecting space.
5. Pulsator according to Claim 4, wherein the sensors have an elongated shape and the longitudinal direction of the sensors is directed perpendicularly to the circumferential direction of the collecting space.
- 25 6. Pulsator according to Claim 5, wherein the sensors are received in the circumferential wall of the collecting space.
7. Pulsator according to Claim 4, 5 or 6, wherein each sample chamber is bounded, on the one hand, by a chamber wall extending into the collecting space from the circumferential wall and, on the other hand, by  
30 the adjacent part of the circumferential wall.
8. Pulsator according to Claim 7, wherein the chamber wall terminates at some distance below the associated feed opening.
9. Pulsator according to Claim 7 or 8, wherein the chamber wall is essentially semicylindrical.
- 35 10. Pulsator according to Claim 7, 8 or 9, wherein the chamber wall is sealed off at the bottom with respect to the circumferential wall and is provided with a drainage opening.
11. Pulsator according to one of the preceding claims, wherein the lid is provided, on its inside, with partitions which extend radially up

to the area between two openings.

12. Pulsator according to one of the preceding claims, wherein there is provided, around each opening, an approximately semicylindrical wall whose open side is directed towards the circumferential wall.



**1/1**

fig -1

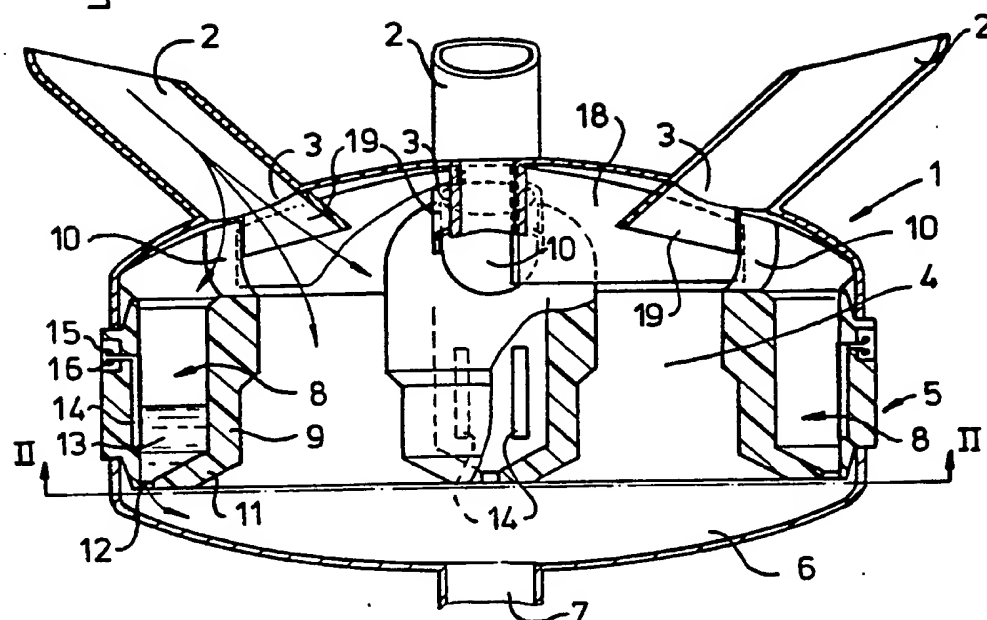
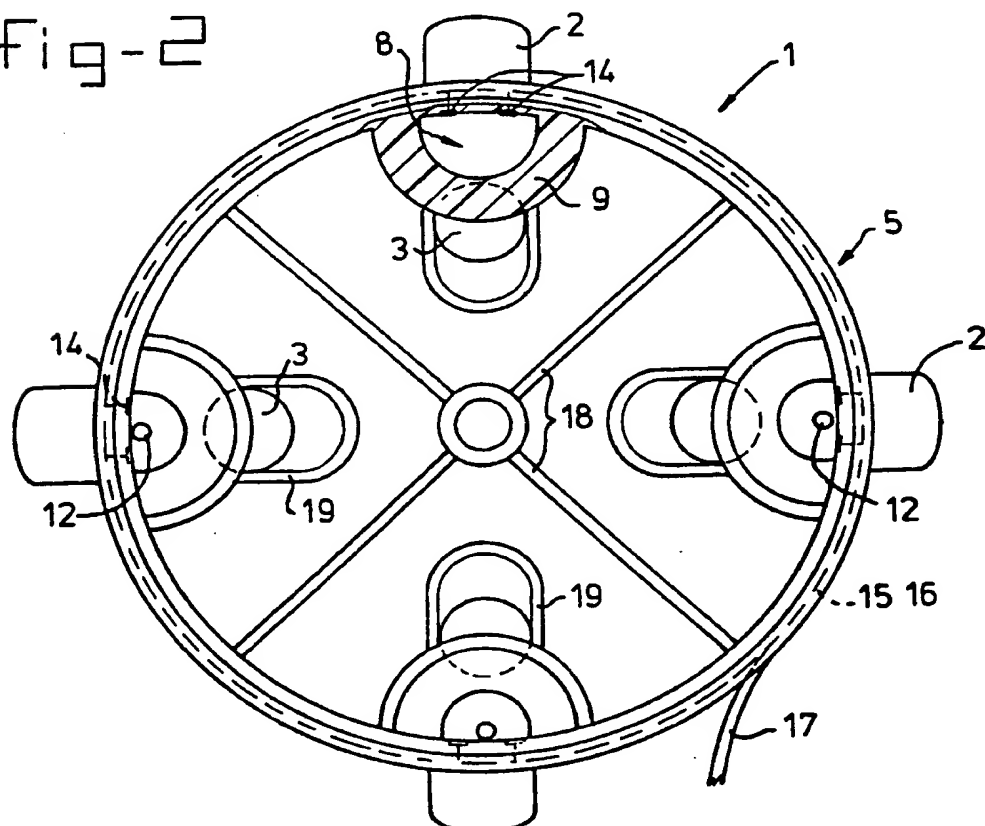


fig-2



# INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 95/00047

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 6 A01J5/04 A01J7/00 G01N33/04

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A01J G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	NL,A,8 301 231 (STICHTING INSTITUUT VOOR MECHANISATIE, ARBEID EN GEBOUWEN) 1 November 1984 see page 1, line 1 - line 6 see page 2, line 22 - page 3, line 32 see claims; figures ---	1-3
A	GB,A,2 257 008 (SIDNEY WILLIAM SIMPSON) 6 January 1993 see page 1, paragraph 1 see page 1, paragraph 4 see page 3, paragraph 4 see claims 1,4,6,7,12; figures --- -/-	1

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

\*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

\*&\* document member of the same patent family

Date of the actual completion of the international search

15 March 1995

Date of mailing of the international search report

30.03.95

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax (+31-70) 340-3016

Authorized officer

Piriou, J-C

# INTERNATIONAL SEARCH REPORT

Int. Application No  
PCT/NL 95/00047

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>EP,A,0 137 367 (EISAI CO LTD) 17 April 1985  cited in the application  see column 3, line 48 - column 5, line 30;  claims; figures</p> <p style="text-align: center;">-----</p>	1

# INTERNATIONAL SEARCH REPORT

Int. Application No

PCT/NL 95/00047

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
NL-A-8301231	01-11-84	NONE	
GB-A-2257008	06-01-93	NONE	
EP-A-0137367	17-04-85	JP-C- 1403961	09-10-87
		JP-A- 60070021	20-04-85
		JP-B- 62010127	04-03-87
		AU-B- 564801	27-08-87
		AU-A- 3322884	04-04-85
		CA-A- 1228831	03-11-87
		SU-A- 1526564	30-11-89
		US-A- 4574736	11-03-86